PUSHPALATHA C. BHAT
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CURRENT POSITION

Senior Scientist
Particle Physics Division & Office of the Director, Fermilab

EDUCATION

Ph.D., 1982, Bangalore University, India
M.Sc. (Physics), 1976, 1st Class, 1st Rank, Bangalore University, India
B.Sc. (Honors) Physics, 1974, 1st Class, 1st Rank, National College, Bangalore, India

APPOINTMENTS

Scientist II 2004 - date; Scientist I, 1997 -2004;
Associate Scientist, 1992 – 97; Research Associate, 1989 – 92, Fermilab
Adjunct Professor and Graduate Faculty, Northern Illinois University, 2001 – date
Research Associate, Duke University, Durham, NC, 1985 – 89
Scientific Officer, Cyclotron Laboratory, Eindhoven University, The Netherlands, 1983 – 85
Research Fellow, Department of Atomic Energy, India, 1976 – 82

PROFESSIONAL HONORS

Fellow, American Association for the Advancement of Science (2008)
Fellow, American Physical Society (2010)

CURRENT ROLES AND ACTIVITIES

Deputy Head, Fermilab Program Planning Office
Board of Directors and Council of the American Physical Society (APS)
Councilor/Member, Executive Committee of the APS Forum on Physics & Society
Secretary, International Committee for Future Accelerators (ICFA)
Secretary, Linear Collider Board (LCB)
Chair, Fermilab Colloquium Committee
Chair, Fermi50 Colloquium Outreach
Member, CMS Collaboration at the LHC
Fermilab/CMS Research Associate Mentoring and Recruiting Committees
Chair, APS Forum on Physics & Society Events Committee
Referee, Several leading physics journals published in the U.S. and Europe

PREVIOUS LEADERSHIP ROLES

Advisor, US CMS Program Management (2014 -16)
US CMS Resource Allocation Advisory Board Member (2014 -16)
Fermilab Strategic Planning team for Accelerator Science (2014 -16)
Organizer, Physics of Sustainable Energy Workshop (PSE-IV) (June 2016)
American Physical Society (APS) Governance Committee (2013-15)
Co-Chair, HEP Community P5 Rollout Campaign Committee (2014-15)
Co-Chair, Higgs Celebration on Capitol Hill Organizing Committee (2012-13)
Co-Convener, DPF Snowmass Science Community Outreach Sub-group (2013)
Chair-line, APS Forum on Physics & Society (2010-14)
Co-Convener, CMS Experiment-Machine Interface Group (2010-12)
Leader, CMS Radiation Simulations & Tools Group (2006-12)
Project Manager & Head, Tevatron Run II Luminosity Upgrades (2004-06), Deputy (2003-04)
Founder/Director, Fermilab Run II Advanced Analysis Methods Group (2001-04)

Leader, DØ Global/Remote Detector & Data Quality Monitoring (2000-03)
Co-Leader, DØ Run II Muon Upgrade System and Reconstruction Software (1997-2001)
Convener, DØ Top Physics Multivariate Analysis (MVA) Methods Group (1994-1997)
Head, DØ Production/Reconstruction Database & Tools (1993-1996)
Co-chair, DØ Computing & Analysis Planning Board (1992-1994)
Leader/Coordinator, DØ NW test beamlines (1989-92)

PRINCIPAL CONTRIBUTIONS

- **Advanced Analysis Methods:** Leadership in the development and applications of advanced analysis methods in searches, discoveries and measurements.
  - Initiated (in 1990) and carried out pioneering work in the application of advanced multivariate analysis (MVA) methods, such as neural networks, at DØ, and led their further development. These methods proved to be of tremendous benefit to DØ in Run 1, in top quark physics and beyond. (DPF Conf. 1994:0705-709; D0 Notes 2594, 2638; *Int. J. of Mod. Phys*. **13**: 5113-5218 (1998); *Annu. Rev. Nucl. Part. Sci*. **61**:281-309 (2011).)
  - Founded and directed Fermilab Run II Advanced Analysis Methods Group to inspire and educate CDF and DØ physicists to embrace these methods. (2001-04). Helped educate the community about these methods through lectures, workshops and published articles.
  - Developed novel algorithms for significant background suppression in top quark searches and for optimization of event selection cuts, both critical for discovery. (1993-96) (DØ Notes # 2225, 2226, 2794.)
  - Made the first precision measurement of top quark mass in DØ using neural networks (1995-97). (*Phys. Rev. Lett*. **79,** 1197 (1997); *Phys. Rev. D* 58:052001 (1998).)
  - Co-developed Random Grid Search (RGS) and a technique for Bayesian fitting of multi-source data; both techniques were extensively used in top physics measurements. (DØ Note #2791; *Phys. Lett*. **B 407**, 73 (1997))
  - Initiated the use of multivariate analysis methods in all top decay channels including all-jets and in single top quark searches.
  - Obtained world's best limit on the mass of the first generation scalar leptoquarks excluding the interpretation of HERA high Q^2 excess as leptoquarks production. (*Phys. Rev. Lett*. **80,** 2051 (1998).)
  - Demonstrated the critical role that Multivariate analyses will play in the search for a low mass Higgs boson in WH and ZH channels at the Tevatron. (*Phys. Rev. D* **62**, 074022 (2000).)
  - Advocated early and extensive use of multivariate methods in CMS. Contributed to Higgs discovery at CMS in the diphoton and four-lepton channels.

- **Fermilab Run II Luminosity and Reliability Upgrades:** Critical contributions to the management of the Run II Tevatron collider Luminosity & Reliability upgrades during the critical years of 2003-06, when the upgrade project turned into a success story.
  - L1 Management: Project Manager (Asst./Deputy: 2003-04, PM & Head: 2004-06).
  - *AIP Conf. Proc.* 753, p30-41 (2004).
  - Provided leadership for the upgrades alongside Jeff Spalding.
  - Held dozens of technical reviews at the start, refined and shaped scope; developed and implemented successful strategies for upgrades.
  - Recognizing the importance of beam instrumentation, advanced Beam Position Monitors and other instrumentation upgrades in the Tevatron early on, leading to both better understanding of the beam and significantly improved performance, as well as smooth and more effective commissioning of other upgrades.

- Proposed the idea of injecting antiprotons into the Tevatron both from the accumulator and the Recycler, to expedite the commissioning of the Recycler while the rapid transfers were being prepared for implementation. Got a team on board to develop the scheme and implementation. This mode of operation provided gains in delivered luminosity and enabled smooth commissioning of the Recycler and rapid transfers.
- The Run II accelerator upgrades program was a spectacular success, ultimately delivering over 10 fb^{-1} each to CDF and DØ, leading to a rich harvest of physics, including single top quark observation and evidence for Higgs in the WH/ZH channels.

■ **Experiment Commissioning and Operations:** Significant contributions to the DØ and the CMS programs, including test beams, detector integration/commissioning/operations.
- Led the DØ test beamline efforts in Neutrino West, critically important for calibration of the DØ calorimeters, including design/commissioning of a new, novel tertiary low energy beamline. (DØ Note 1104)
- Co-led the Run II Muon systems/reconstruction software group at DØ that developed the first C++ reconstruction package for commissioning and offline reconstruction.
- Designed and led the development of the global monitoring system that enabled monitoring of the detector and data quality in the DØ control room and remotely from institutions across the world. http://www.fnal.gov/pub/ferminews/ferminews03-01-31/p2.html
- Led the efforts on extensive simulations of the radiation environment in the CMS detector during LHC operations from pp collisions, machine-induced backgrounds and beam accident scenarios. Developed innovative tools for access to data. (CMS Notes 2009-019; 2013-001)
- Co-convened the CMS-LHC machine interface group.

■ **Leadership in HEP and Broader Science Community:** Active leader in HEP community and broader science community in an effort to build constructive relationships with policy makers and decision leaders.
- Leadership of the US HEP community's outreach to Congress, OSTP, and funding agencies, most recently in celebrating the Higgs discovery on the Hill (Nov. 20, 2013), and a successful campaign in support of the P5 strategy (2014).
- Leadership in the broader science community, through APS and AAAS, on issues of science & society, especially as pertains to federal funding of basic science research and US leadership in science.
- Organized, chaired and moderated several distinguished panel sessions on topics of U.S. Scientific Research enterprise and "American Science and America's Future."

OTHER SPECIFIC CONTRIBUTIONS

A. SCIENTIFIC:

CMS Experiment (2006-date):

■ Contributions to Higgs Boson Discovery
- ➢ Major contributions to Bayesian Neural Network analysis as cross-check to the standard matrix-element method analysis in the H→ZZ→4l channel.
- ➢ Likelihood analysis of data in H→γγ channel as cross-check of the signal seen in the standard discovery analysis.
- ➢ Having demonstrated significant gains in Higgs searches at the Tevatron with the use of multivariate analysis (MVA) methods, strongly advocated the use of MVA in several aspects of Higgs boson searches in CMS from the very start; wrote a pedagogical review article

[*Annu. Rev. Nucl. Part. Sci*. **61**:281-309 (2011)] to encourage the use of MVA; use of MVA proved critical in the discovery of the Higgs boson in CMS.

Higgs Discovery Strategy at Tevatron Run II (1999-2001):

- Demonstrated the critical role that Multivariate analyses will play in the search for a low mass Higgs boson in WH and ZH channels at the Tevatron.
  - As part of the Run II SUSY/Higgs Workshop, demonstrated that with the use of neural networks the required luminosity for discovery can be reduced by a factor of two relative to that required for a conventional analysis. (Phys. Rev. D **62**, 074022 (2000); Run II SUSY/Higgs Workshop Report, arXiv:hep-ph/0010338)
  - This result provided the impetus for the concerted effort for luminosity upgrades of the Tevatron accelerator complex.

Top Quark Discovery & Top Physics in Run 1 (1990-98):

- Made critical contributions towards top quark discovery in DØ
  - Calibration of the calorimeter at low energy with test beams
  - Developed Z-fitter algorithm and code for suppressing (Z+jets) backgrounds in muon channels (top decays in dimuon and muon+jets) by factors of 3 to 5, critical for discovery
  - Developed optimization methods for event selection in top searches, particularly in lepton +jets channels which played key roles in the discovery in 1995
- Precision measurement of the top quark mass at DØ
  - Made the first precision measurement of top quark mass in DØ using neural networks, reducing the statistical error by more than a factor of two relative to conventional analysis, producing a result competitive with CDF which had a silicon vertex detector in Run I.
  - Co-developed a technique for Bayesian fitting of multi-source data; employed the method in top quark mass measurement
- Observation of top pairs in all-jets final states
  - Inspired and initiated the use of MVA in several aspects of top search in the all-jets final state, including grid searches, quark-gluon jet discrimination and signal/background discrimination.
- Initiated neural network analyses in single top searches in DØ; Single top production was observed in Run II of the Tevatron using the MVA methods.
- Convener of DØ top multivariate group
  - Led the development of several MVA methods applied in top quark physics studies (and new particle searches) at DØ
- Review article: "Top Quark Physics at the Tevatron," *Int. J. of Mod. Phys*. **13**: 5113-5218 (1998).

New Particle Searches in DØ (1997-2005):

- Searches for Leptoquarks in DØ
  - Using MVA, obtained world's best limit on the mass of the first generation scalar leptoquarks excluding the interpretation of HERA high Q^2 excess as leptoquarks production (*Phys. Rev. Lett*. **79,** 4321 (1997); *Phys. Rev. Lett*. **80,** 2051 (1998).)
  - Provided guidance on searches for second generation leptoquarks
- Searches for Technicolor particles in DØ
  - Initiated and guided first searches for Technicolor particles in DØ Run 1 using MVA

B. TECHNICAL:

CMS Experiment (2006-date):

- CMS Tracker Outer Barrel integration, commissioning (2005-10)
  - Tracker integration before installation and performance studies
    - http://cmsinfo.web.cern.ch/cmsinfo/Media/Publications/CMStimes/2007/03_19/index.html
  - Initiated the development of Tracker Data Quality Monitoring (DQM)
  - Extensive Radiation Simulation Studies for the tracker
- Broad contributions to CMS detector commissioning and operations
  - Shift Leader, CMS control room during commissioning and operations (2009-10)
  - Coordinator, Beam background studies and interfacing with LHC machine groups
- Co-convener, CMS Experiment-Machine Interface Group (MIG) (2010-12)
- Leader, CMS radiation simulations and tools group (2006 -12)
  - Led the efforts on extensive simulations of the radiation environment in the entire CMS detector during LHC operations from pp collisions, machine-induced backgrounds such as beam-gas and beam-halo, and studied several beam accident scenarios. (MARS and FLUKA monte carlo code used for simulations.)
  - Designed and developed a web interface Radiation Dose/Fluence Calculator/Plotter tool that got widely used in the CMS collaboration and inspired further such developments within the CMS MIG and Beam Radiation Instrumentation & Luminosity (BRIL) groups.

Global/Remote International Monitoring of the DØ Experiment:

- DØ Global/Remote Detector and Data Quality Monitoring
  - Leader (2000-03)
  - Designed and spearheaded the development of the Global Monitoring (GM) system
    - Framework for Physics, Trigger and Detector Examines plus a suite of monitoring and communication tools
  - GM allowed detector and data quality monitoring in real time both in the DØ control room and from remote locations around the world.
  - Provided input to the design and development of remote operations center of the CMS experiment at Fermilab.

Software and Computing:

- Run II Muon systems/reconstruction software group at DØ
  - Co-convener (1997-2001)
  - Led the group to deliver the first C++ software package for DØ Run II, used in the commissioning of the muon systems and in muon track reconstruction.
- DØ Production/Reconstruction Database and Tools (1993-96)
  - Led the design and development of numerous software packages and tools for data management, production management and databases for DØ.
- Co-led the development of the Analysis Computing Model for DØ Run 1b.
- Led the DØ migration from VMS to Unix.
- Served on Fermilab Unix task force -- Contributed to writing of the "Unix at Fermilab" manual, to many system/product tests, tutorials and implementation.

DØ Test Beams, Detector Calibration & Commissioning (1989-92):

- Led the NW test beamline efforts critically important for calibration of the DØ calorimeters
  - Instrumented, upgraded and operated (primary,) secondary NW test beamline
  - Led the design/installation/commissioning/operation of a tertiary beamline (the first ever of the kind at Fermilab) for low energy electrons and pions.
  - Studied low energy response of the DØ calorimeters

C. MANAGERIAL/ORGANIZATIONAL:

- Secretary, International Committee for Future Accelerators (ICFA) and Linear Collider Board (LCB) (Feb. 2016-)
  - Duties include organizing several ICFA/LCB meetings each year, working closely with the Chairs; help run the meetings and generate and circulate the minutes.
  - Communicate frequently with chairs, members and several ICFA panel chairs on topics of discussion and activities within ICFA, LCB and other ICFA panels.
  - For more details about ICFA activities, see http://icfa.fnal.gov
- Coordinator of Scientist Emeritus program (2016 -)
- Deputy Head, Program Planning (May 2015 -)
  - Provide guidance to new Fermilab experiments on preparing Experimental Operations Plan, conducting Operational Readiness Reviews (ORR) and facilitate integrating strategic planning and performance management into program planning.
  - Shared responsibilities for weekly All Experimenters' and Lab Status meetings, and facilitating experiment management meetings.
  - Oversight of Fermilab technical publications.
- Organizational Roles in CMS
  - Advisor, US CMS Program Management (2014 -16)
  - Leader, Radiation Simulations and Tools (2007-2012)
  - Co-Convener, CMS-LHC Experiment Machine Interface Group (2010-12)
  - Facilitator, US CMS Technical Advisory Board (2009-10)
  - Coordinator, Tracker DQM (2007-08)
- Project Manager, Run II Luminosity & Reliability Upgrades of the Fermilab Accelerator Complex (2003-06)
  - Project Manager & Head (Nov. 2004- Feb. 2006); Asst./Deputy PM (2003-Nov. 2004), Reviews Coordinator (2003)
  - Conducted dozens of internal technical reviews to refine scope of the Run II upgrades -- praised by Lehman's review committee during DOE reviews in the fall of 2003
  - Coordinated and led the accelerator division teams to prepare for reviews and prepare necessary documentation
  - Handled the management of implementing a broad program of upgrades in all machines across the accelerator complex – Linac, Booster, Shielding for CDF, Antiproton target, Lithium lens, Main Injector RF upgrades, Tevatron helical separators, Recycler commissioning, Electron Cooling of Antiprotons, Rapid transfers of Antiprotons, Beam diagnostics, Beam loss monitors, etc.
  - Developed optimal strategies and priorities for the upgrades program, streamlined and focused the program on principal objectives and managed the implementation of upgrades amidst Tevatron collider operations.
  - Interacted with hundreds of upgrades project personnel from all over the laboratory, which helped boost morale as well as in producing great results.
  - During this critical period 2003-06, 88% of the upgrades and all major milestones were completed and the Tevatron launched into the fb^{-1} integrated luminosity era.
- Founder/Director, Run2 Advanced Analysis Methods Group (2001-04)
  - Initiated and established a lab-wide group, to bring on board physicists from both CDF and DØ collaborations (and other Fermilab experiments) to learn about, explore and use the multivariate methods in physics analyses.
  - Through workshops, lectures by experts, tutorials and regular meetings, many multivariate analysis methods such as neural networks, boosted decision trees, fisher discriminants, support vector machines methods that were used by the collaborations in Run 2 were introduced and developed with example analyses.

- Head, Global Monitoring of the DØ experiment (2001-03)
  - Led and managed the design and development of detector, data quality, physics and trigger online monitoring for the DØ experiment
  - Designed, developed and implemented remote monitoring, thereby enabling remote DQM shifts with tools for real time interactions between DØ control room and remote shifters. "DØ goes global" http://www.fnal.gov/pub/ferminews/ferminews03-01-31/p2.html
- Head, DØ Production/Reconstruction/tapelog Database & Tools (1993-1996)
  - Developed smart methods and tools for production management and database use
- Co-chair, DØ Computing & Analysis Planning Board (1992-1994)
- Led the development of planning for analysis computing facilities and software tools through Run 1, critically important for Run 1b during the top quark discovery era.
- Advanced Computing and Analysis Techniques International Workshop Series (2000 – date)
  - Rebranded the international workshop series on "Artificial Intelligence in High energy and Nuclear Physics (AIHENP)" as "Advanced Computing & Analysis Techniques (ACAT)" and held the first ACAT in October 2000 at Fermilab.
  - Chair, ACAT2000 at Fermilab, with Mathias Kasemann as Co-chair.
  - The workshop at Fermilab led to several impactful initiatives including inspiration for TMVA, implemented in ROOT, a widely used application in HEP for MVA analysis.
  - ACAT workshops are held every 18 months and rotate between various world regions.
  - Serving on the ACAT International Advisory Board.

COMMUNITY LEADERSHIP

- **US High Energy Physics Community Leadership:**
  - Co-chair with Ian Shipsey, **US HEP P5 Rollout Campaign Committee** [DPF/FNALUEC/USLUO/SLUO] (2014-15)
    - Led the drive to develop a strong support in the US HEP community for the P5 report (released May 2014), which resulted in **2331 members** of the community signing on to a letter in support of the P5 report submitted to Energy Secretary Moniz and NSF Director Cordova.
    - Organized and chaired a successful briefing on the P5 report for Senate staff, sponsored by the Senate committee on Energy & Natural Resources (ENR).
    - Meetings with Congressional members/staff and OSTP leaders one-on-one to inform about the status of HEP and P5 report
    - Organized and moderated a community townhall meeting at the Snowmass meeting in Minnesota to discuss the procedures for the P5 process with Jim Siegrist (Associate Director for High Energy Physics Division in DOE Office of Science) and Andy Lankford, HEPAP Chair.

  - Co-Chair with Ian Shipsey, **HiggsFest on Capitol Hill** (2013)
    - Organized HEP Community Congressional visits and celebration of Higgs Discovery and US Contributions; Participation by 10 members of Congress (five of them spoke), several VIP agency leaders and ~300 total participants;
      Event raised awareness in Congress and OSTP about HEP and US HEP @CERN and has had a huge positive impact.
      http://dpfnewsletter.org/?p=988#ch5
      https://indico.fnal.gov/conferenceDisplay.py?confId=7983
      http://www.aps.org/publications/apsnews/201401/higgsbosonday.cfm
      http://www.aps.org/publications/capitolhillquarterly/201311/upload/November-2013.pdf

- Subgroup Co-convener with Joe Lykken, HEP Outreach to the Broader Science Community, "Snowmass 2013 Community Summer Study: Planning the Future of U.S. Particle Physics"
  - http://arxiv.org/pdf/1401.6119.pdf (Chapter 10)
  - Organized a pre-meeting brain-storming session at Fermilab
  - Organized two panel sessions at the meeting in Minnesota
  - Organized a community townhall meeting on the P5 process at Snowmass
    - This was the first community townhall meeting in the P5 process!
- Future Energy Frontier Machines – Formed a working group; submitted a whitepaper to "Snowmass 2013" proposing future e+e-/pp colliders in a 100 km ring based at Fermilab.
  - http://arxiv.org/abs/1306.2369 also see http://physicsbuzz.physicscentral.com/2013/06/the-very-large-hadron-collider.html
  - Talks: (1) 5th TLEP Workshop at Fermilab (July 25-26, 2013)
    (2) DPF2013 at UC Santa Cruz (Aug. 13-17, 2013)

GRADUATE AND UNDERGRADUATE STUDENTS

Advisor/mentor for several dozen Ph.D. students and M.S. students

- Graduate Advisees :
  - Jeffrey McDonald, Ph. D. 1999, Florida State University (FSU)
  - Russell Gilmartin, M.S. 2001, FSU
  - Xioafei Song, Ph. D. 2005, Northern Illinois University (NIU)
  - Xuegang Xia, M.S., 2007, NIU
  - Anil Singh, Ph.D. 2010, Panjab, India
  - Joe Bochenek, Ph.D., 2013, FSU
  - Kenan Caymaz, NIU
  - Graham Stoddard, M.S. (2015)
- Mentored dozens of other graduate students and postdocs from US and non-US universities
- Supervised well over thirty undergraduate students/interns in research; some have pursued or pursuing graduate studies in physics or a related field, others employed in industry.

OTHER PROFESSIONAL ACTIVITIES/SERVICE

- APS Board of Directors (2017 -) and APS Council (2016 -)
- APS Wilson Prize Committee (2017)
- APS Audit Committee (2017 -)
- Co-organizer, Short Course/Workshop on "*Physics of Sustainable energy* - IV," June 17-18, 2016, University of Chicago, Chicago, IL
- The American Physical Society Forum on Physics & Society (FPS)
  - FPS Vice-Chair 2010-11, Chair-Elect 2011-12, Chair 2012-13, Past Chair 2013-14.
  - FPS Secretary-Treasurer, 2007-10
- Chair, APS/FPS Fellowships Committee 2012
- Chair, FPS Program Committee 2012, 2013; Member, APS Program Committee 2012
- APS Governance Committee 2012 –
  - (Formerly known as Constitution and By-Laws Committee)
- American Physical Society/FPS Awards Committees
  - Chair, Leo Szilard Lectureship and Burton Forum Awards Committees, 2013
- Fermilab Colloquium Committee Chair (Jan. 2015 –date), Member (2013-2014; 1996-98)
- Fermilab Chief Information Officer (CIO) Search Committee (2014)
- Fermilab General Accelerator R&D Task Force to provide input to the HEPAP subpanel on accelerator R&D (2014)

- Fermilab working group of "Snowmass" Conveners'
- Fermilab RA Recruiting Committee, Member, 2007-2010
- Fermilab CMS RA Recruiting Committee, Member, 2012-
- Awardee, NSF Grants in 2000 and 2003-06
- Reviewer (occasional) for NSF and DOE SBIR Grants
- Referee for publications
    - Physical Review, Physical Review Letters, Physics Letters,
    - European Journal of physics C, IEEE journals, .. 1997 –
- Organizing Committee, Fifth CERN-Fermilab Hadron Collider Physics Summer School, 2010.
- Organizing Committee, International Symposium on Lepton-Photon Interactions, August 2003.
- Advanced Computing & Analysis Techniques (ACAT) International Workshop Series
    - Member, International Advisory Committee (1998- date)
    - Track Coordinator, Program Committee, Reviewer (2000-2010)
- Committee on Fermilab Summer Internships in Science & Technology, 1996-2000
- Leader, DOE Tiger Team Escort Fermilab Source Book Task Force, 1992
- Public Outreach through Fermilab, 1989 – date
    - Volunteer at Open Houses, Ask-a-Scientist volunteer (several sessions) & speaker
- Several Lectures to the Public and Students, 1990 – date

SELECTED PUBLICATIONS

1. P.C. Bhat, for the CMS Collaboration, "Observation of a Higgs-like Boson in CMS at the LHC," *Nucl. Phys. B Proc. Suppl.*, Vol. **234**, 7 (2013).

2. P.C. Bhat, "Multivariate Analysis Methods in Particle Physics," *Annu. Rev. Nucl. Part. Sci*. **61**:281-309 (2011). **(*Review Article*)**

3. P.C. Bhat and W. J. Spalding, "Fermilab Collider Run II: Accelerator Status and Upgrades," Proc. 15th Conf. on Hadron Collider Physics, *AIP Conf. Proc*., 753, p. 30-41 (2004).

4. P.C. Bhat, "Run II Physics at the Fermilab Tevatron and advanced analysis methods," *Nucl. Inst. & Meth. A. Proc. Suppl.* **502**, 327 (2003).

5. P.C. Bhat, "New Directions in Data Analysis," *Int. J. Mod. Phys*. A, **16**, Suppl. 01C, 1122 (2001).

6. P.C. Bhat, R. Gilmartin, H.B. Prosper, "Strategy for discovering a low-mass Higgs Boson at the Fermilab Tevatron," *Phys. Rev*. **D 62**, 074022 (2000).

7. P.C. Bhat, H.B. Prosper, S.S. Snyder, "Top Quark Physics at the Tevatron," *Int. J. of Mod. Phys*. **13**: 5113-5218 (1998). **(*Review Article*)**

8. P.C. Bhat, H.B. Prosper, S.S. Snyder, "Bayesian Analysis of Multi-source Data," *Phys. Lett*. **B 407**, 73 (1997).

9. P.C. Bhat, "Search for the Top Quark using Multivariate Analysis Techniques," *Proceedings of the DPF '94 meeting,* FERMILAB-CONF-94-261-E, DPF Conf. 1994:0705-709.

10. P.C. Bhat, L. Lonnblad, K. Meier, K. Sugano, "Using Neural Networks to identify jets in hadron-hadron collisions," published in 1990 DPF summer study in High Energy Physics: Research Directions for the Decade, p. 0168-173 (1990).

11. P.C. Bhat with C.M. Bhat, M. Paterno and H.B. Prosper, "Study of the Solar Neutrino Survival probability," *Phys. Rev. Lett.* **81**, 5056 (2013).

12. W.D. Walker and P.C. Bhat, "Hadron-Nuclear Interactions," Book Chapter in *Advanced Series on Directions in High Energy Physics* Vol. **2**, Hadronic Multiparticle Production, p. 153-210, Ed. P. Carruthers, World Scientific, (1988). **(*Review Article*)**

13. ATLAS and CMS Collaborations, "Combined measurement of the Higgs boson mass in pp collisions at √s = 7 TeV and 8 TeV with the ATLAS and CMS experiments," *Phys. Rev. Lett.* **114**, 191803 (2015).

14. CMS Collaboration, "Precise determination of the mass of the Higgs boson and tests of compatibility of its couplings with the standard model predictions using proton collisions at 7 and 8 TeV," *Eur. Phys. J.* **C75**, 5, 212 (2015)

15. CMS Collaboration, "Measurement of the properties of a Higgs boson in the four-lepton final state," *Phys. Rev. D* **89**, 092007 (2014).

16. CMS Collaboration, "Search for Contact interactions using inclusive jet pT spectrum in pp collisions at √s = 7 TeV," *Phys. Rev. D*., **87**, 052017 (2013).

17. CMS Collaboration, "Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC," *Phys. Lett.* **B 716**, 30 (2012).

18. CDF and DØ Collaborations, "Evidence for a particle produced in association with weak bosons and decaying to a bottom-antibottom quark pair in Higgs boson searches at the Tevatron," *Phys. Rev. Lett.* **109**, 071804 (2012).

19. DØ Collaboration, "Observation of Single Top-quark Production," *Phys. Rev. Lett.* 103, 092001 (2009).

20. CMS Tracker Collaboration, "Performance Studies of the CMS strip tracker before installation," *JINST* **4**, P06009 (2009).

21. CMS Collaboration, "The CMS experiment at the CERN LHC," *JINST* **3**, S08004 (2008).

22. DØ Collaboration, "Search for single top quark production at DØ using neural networks," *Phys. Lett.* **B517**, 282 (2001).

23. DØ Collaboration, "Search for First Generation Scalar Leptoquark Pairs in pbar-p collisions," *Phys. Rev. Lett*. **80,** 2051 (1998).

24. DØ Collaboration, "Direct Measurement of the Top Quark Mass," *Phys. Rev. Lett*. **79,** 1197 (1997); *Phys. Rev. D* 58:052001 (1998).

25. DØ Collaboration, "Observation of the Top Quark," *Phys. Rev. Lett.* **74,** 2632 (1995).

[Co-author of over 1000 publications in experimental high energy physics as a collaborator on CMS, DØ, E-735 (CØ), E-743 (Charm hadroproduction with 800 GeV protons), E-597 (Hadron-nuclear interactions) experiments]

PROCEEDINGS EDITED

1. P.C. Bhat and M. Kasemann, Proceedings of the International Workshop on *Advanced Computing and Analysis Techniques in Physics Research*, AIP Conf. Proceedings, Batavia, IL, Vol. 583, (2000).

2. P.C. Bhat, G. Crabtree, R. Knapp and R. Rosner, Proceedings of the IV Conference on *Physics of Sustainable Energy*, Chicago, IL, AIP Conf. Proceedings, (2017). (Under preparation)

SELECTED/INVITED TALKS

1. "Fifty Years of Particle Physics and Discoveries at Fermilab," Colloquium at Instituto de Fisica Corpuscular (IFIC), Valencia, Spain, February 15, 2017.

2. "The Higgs Boson Discovery and Future of Particle Physics," Public Lecture co-sponsored by the Indian Physics Association, Indian Institute of Astrophysics and Karnataka Association for the Advancement of Science, Bangalore University, Bangalore, India, November 30, 2016.

3. "Data Analysis in High Energy Physics," Lecture at the Center for High Energy Physics, Indian Institute of Science, Bangalore, India, November 29, 2016.

4. "Particle Physics at the Energy Frontier," Physics Department Seminar, Hosted by Center for High Energy Physics, Indian Institute of Science, Bangalore, India, November 29, 2016.

5. "American Science and America's Future," Lannutti Memorial Public Lecture, co-hosted by the Tallahassee Scientific Society and the Florida State University Department of Physics, FSU College of Medicine Auditorium, Tallahassee, FL, Nov. 18, 2015.

6. "Future of Particle Physics in the New Age of Global Science," Lannutti Memorial Campus Lecture, co-hosted by the Tallahassee Scientific Society and the Florida State University Department of Physics, FSU Physics Department, Tallahassee, FL, Nov. 19, 2015.

7. "Future Accelerators," Plenary talk at the APS Division of Particles & Fields Meeting, Ann Arbor, Michigan, August 4 -8, 2015.

8. "Anomalies in Searches from Run 1 and What to Watch for in Run 2 at the LHC," invited plenary talk at the APS Division of Particles & Fields session, APS meeting, Baltimore, MD, April 11-14, 2015.

9. "Discovery of the Higgs Boson and Future of Particle Physics," invited plenary talk at the Annual meeting of the APS Prairie Section, Monmouth, IL, Nov. 21-22, 2014.

10. "Electroweak Precision Physics at the LHC," invited plenary talk at Particles & Nuclei International Conference 2014 (PANIC2014), DESY, Hamburg, Aug. 24-29, 2014.

11. "Searches for the Standard Model Higgs Boson at the Tevatron and CMS; the Discovery of a new (what might be a Higgs) boson," invited plenary talk on July 6, 2012, at the 16th High Energy Physics International Conference in Quantum Chromodynamics (QCD2012), Montpellier, France, July 2-6, 2012. Nucl. Phys. B (Proc. Suppl.), Vol. **234**, 7 (2013).

12. "Data Analysis Algorithms and Tools," Workshop Summary talk at ACAT2011 International Workshop, Brunel University, Uxbridge, London, U.K., September 5 -9, 2011.

13. "Multivariate Analysis Techniques in HEP", HEP Seminar at Argonne National laboratory, April 13, 2011.

14. "Multivariate Analysis Methods: Theory and Practice" Seminar at the LHC Physics Center, Fermilab, Feb. 25, 2011.

15. "Multivariate Analysis: An overview, the Tevatron Experience and the Future", CMS Multivariate Analysis Methods Workshop, CERN, December 13, 2010.

16. "Tevatron Collider Physics with Multivariate Methods: Two Decades of History," CMS Physics Workshop, CERN, December 12, 2007.

17. Moderator, Round Table Discussion on "Multivariate Methods in HEP," International Workshop on Advanced Computing and Analysis Techniques in Physics Research, Amsterdam, The Netherlands, April 24-27, 2007.

18. "DØ Global Monitoring and Outlook for LHC/CMS remote monitoring," International Workshop on Advanced Computing and Analysis Techniques in Physics Research Amsterdam, The Netherlands, April 24-27, 2007.

19. "Multivariate Methods in HEP," SAMSI (Statistical and Applied Mathematical Sciences Institute) workshop, Research Triangle Park, North Carolina, March 2006.

20. "Bayesian Neural Networks," PHYSTAT05 International Workshop, Oxford University, Oxford, U.K., September 2005.

21. "Electroweak and top physics results from Dzero," 10th International symposium on Particles, Strings and Cosmology, PASCOS 2004, Boston, August 16-22, 2004, published in Proceedings (World Scientific), p. 245-258.

22. "Run II Physics at Fermilab and Advanced Analysis Methods," International Workshop on Advanced Computing and Analysis Techniques in Physics Research, June 2002, Moscow, Russia. Published: *Nucl. Inst. & Meth. A,* Proc. Suppl. **502**, 327 (2003).

23. "Advanced Analysis Methods for Higgs in Run II," Workshop on Future of Higgs Physics, May 3-5, 2001, Fermilab, Batavia, IL.

24. "Prospects for Standard Model Higgs at the Tevatron," APS / DPF / DPB Summer Study on the Future of Particle Physics (Snowmass 2001), Snowmass, Colorado, 30 Jun - 21 Jul 2001.

25. "Search for New Physics at the Tevatron," PHENO-CTEQ symposium, University of Wisconsin, Madison, March 2001.

26. "Advanced analysis methods in high-energy physics," 7th International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT 2000), Batavia, Illinois, 16-20 Oct 2000, published in AIP Conf.Proc.583:22-30, 2001.

27. "New Directions in Data Analysis," Talk presented at the Division of Particles & Fields Meeting, Columbus, OH, August 9-12, 2000, Int. J. Mod. Phys. A16S1C (2001) 1122.

28. "Prospects for Higgs Discovery at the Tevatron," 7th International Conference on SuperSymmetry in Physics, June 1999, Batavia, IL.

29. "Search for New Physics at the Tevatron," PHENO-CTEQ Symposium, March 23-26, 1998, Madison, Wisconsin.

30. "Technicolor: Status and Prospects," High energy Physics Seminar, Argonne National Laboratory, March 4, 1998.

31. "Strong Dynamics at the Muon Collider: Working group Report," Workshop on Physics at the First Muon Collider and at the Front End of a Muon Collider, Fermilab, Batavia, IL, November 6-9, 1997.

32. "Search for Leptoquarks at the Tevatron," VIII Lomonosov Conference on Elementary Particle Physics, August 25-30, 1997, Moscow, Russia.

33. "Top Quark Physics at the Tevatron," VIII Lomonosov Conference on Elementary Particle Physics, August 25-30, 1997, Moscow, Russia. (Fermilab-Conf-98/097-E).

34. "New Results on the Top Quark from DØ," Joint Experimental-Theoretical Physics Seminar, Fermilab, February 21, 1997.

35. "Measurement of the ttbar Production Cross section at DØ," XXXI Rencontres de Moriond: QCD and High Energy Hadronic Interactions, 1996, published in the Proceedings, p. 11 (Editions Frontiers).

36. "Search for the Top Quark at DØ using Multivariate Methods," 10th Topical Workshop on Proton-Antiproton Collider Physics, (May 1995, Batavia, Illinois), Published by AIP Woodbury, New York, 1995, p308.

37. "Search for the Top Quark using Multivariate Analysis Techniques," Proceedings of the eighth meeting of the Division of Particles & Fields of the American Physical Society, Albuquerque, NM, 1994. Published in the proceedings of the '94 DPF meeting, FERMILAB-CONF-94-261-E, DPF Conf. 1994:0705-709 (1994).

38. "Search for the Top Quark and other New Particles at DØ," at the V Blois Workshop, International Conference on Elastic and Diffractive Scattering, June 1993, Published by World Scientific, 1993.

PANEL/PLENARY SESSIONS ORGANIZED AND CHAIRED/MODERATED

[Panelists have included President's Advisors, Funding Agency leaders, University Presidents, Laboratory Directors, Nobel Laureates, Celebrity Physicists, Congressmen]

- 2017 APS April Meeting – Organized the Opening Plenary/Panel Session on "Science Policy in the 21st Century," with Cherry Murray, Rush Holt and Bill Foster as speakers. (Chaired by Laura Greene, APS President)

- 2016 APS AAAS meeting – Chair/Moderator, Panel Session on "Grand Visions for the Future of U.S. Science." Panel: John Holdren, Lynn Orr, France Cordova, Charles Bolden.

- 2015 APS April Meeting – Chair/Moderator: Panel Session on "Big Science & Big Challenges". Panel: Norm Augustine, John Grunsfeld, John Mather, Nigel Lockyer.

- 2014 APS March meeting – "Impacts of Physics Research on the Economy" Speakers/Panelists: Peter Littlewood (ANL), David Lee (EPS), Thomas Baer (Stanford), Venkat Selvamanickam (UHouston).

- 2014 APS April Meeting – "Physics Research and Innovation", Speakers: Nathaniel Fisch (Princeton), Eric Fossum (Dartmouth), Hasan Padamsee (Cornell/Fermilab).

- 2013 APS March Meeting "American Science & America's Future" Speakers: Reps. Rush Holt (NJ), Bill Foster (IL), Randy Hultgren (IL), Maxine Savitz (NAE), Neil Gershenfeld (MIT) .

- 2013 April Meeting "The Future of U.S. Research Enterprise" Speakers/Panelists: Bob Zimmer (President of UChicago and FRA), Lisa Randall (Harvard), Jim Gates (PCAST/Maryland), Kate Kirby (APS).

- An evening symposium on "Applications of Physics to Biological and Social Structures" featuring Leo Szilard Lectureship Prize awardee Geoffrey West (Los Alamos).

- **"Forum at Forty, Celebrating Fortieth Anniversary of the Forum on Physics & Society."** (Highlight of the Event: A congratulatory letter from President Obama. Discussion on the history of FPS and the future.)

- 2012 April APS Meeting, March 31 – April 3, 2012, Atlanta, GA "American Science & America's Future", Panel: Frank Wilczek, Jim Siegrist, Tim Hallman, Neal Lane

- "Applications of Accelerators," Speakers: Murray Gibson, Cynthia Koppel, Richard Sheffield, 2009 April APS meeting, May 2-5, Denver, CO.

- "Global Physics Projects", 2009 April APS meeting, May 2-5, Denver, CO. Speakers/Panelists: Chris Llewellyn Smith, Dennis Kovar, Jack Gibbons, Pier Oddone. Co-chair: Lawrence Krauss

- Public Town Hall meeting on "Science & Society", 2009 April APS meeting, May 2-5, Denver, CO.

IN THE NEWS

- Physics & Society Newsletter, April 2016, on "Grand Visions for the Future of U.S. Science," https://www.aps.org/units/fps/newsletters/201604/science-agency.cfm
  Fermilab News
  http://news.fnal.gov/2016/03/science-agency-leaders-discuss-future-u-s-science/

- Women @ Energy Profile, August 2015
  https://www.energy.gov/diversity/articles/women-energy-pushpalatha-c-bhat

- Boston Globe Editorial, April 19, 2015:
  https://www.bostonglobe.com/opinion/editorials/2015/04/18/exploring-origins-cosmos-shouldn-settle-for-second-best/ar5cv91XSARm6VHZ38KEDJ/story.html

- Fermilab Today on "Big Science & Challenges", April 23, 2015
  http://www.fnal.gov/pub/today/archive/archive_2015/today15-04-23.html

- American Academy of Arts & Sciences Discussion on "Restoring the Foundation", Nov. 2014
  http://www.cryogenicsociety.org/csa_highlights/restoring_the_foundation/

- Advocacy for Fermilab, USHEP:
  Physics Today: http://physicstoday.org/journals/doc/PHTOAD-ft/vol_61/iss_7/24_1.shtml

- US Leadership on Science:
  Bloomberg News: http://www.bloomberg.com/news/2012-06-19/europe-overtakes-u-s-in-physics-pursuing-god-particle.html

- "Why particle physics matters" Aug. 2013
  https://www.youtube.com/watch?v=-kiIeNs8dMA

- HiggsFest on the Hill 2013
  http://www.aps.org/publications/apsnews/201401/higgsbosonday.cfm
  http://www.aps.org/publications/capitolhillquarterly/201311/upload/November-2013.pdf

- APS April 2013 meeting – Panel on "Future of US Research Enterprise"
  http://www.livescience.com/28752-american-science-competitiveness.html

- Visits to congressional offices annually by the APS leadership groups during 2007-11, and in active communication with representatives in congress.
  http://www.aps.org/publications/capitolhillquarterly/201105/upload/chq0511.pdf

- Press conference on "American Science & America's Future" at the APS meeting in Atlanta, GA, April 2, 2012.

  http://www.huffingtonpost.com/2012/04/06/science-america-crisis-physics-society_n_1408244.html
  http://www.foxnews.com/scitech/2012/04/07/crisis-for-us-science-is-looming-physicists-warn/
  http://www.aps.org/publications/apsnews/201206/panel.cfm

- Video Press Conference, "Life & Science at CERN," with senior undergraduate science journalism class from Metropolitan State College, Denver, Colorado, March 8, 2011.

- Keynote Speaker, "The Lure of Science," GEMS (Girl Engineers, Mathematicians & Scientists) 3rd Annual Workshop (for high school girls), Naperville, IL, Aug. 14, 2010.
  http://www.gemsworks.org/in-the-past/2010-workshop/opening-speakers

- Public Lecture via video from CERN, "Discoveries at the Energy Frontier," Bangalore Science Festival, National College, Bangalore, India, July 17, 2010.

- Panel on "Global Physics Projects," at the APS meeting in Denver, Colorado, May 2, 2009.

  http://cerncourier.com/cws/article/cern/39753/6
  http://www.aps.org/publications/apsnews/200906/globalphysics.cfm

- Fermilab Today articles on Run II Tevatron Luminosity upgrades, see,
  http://www.fnal.gov/pub/today/luminosity.html

  http://www.fnal.gov/pub/today/luminosity2.html

- FermiNews article on DØ Global monitoring:
  http://www.fnal.gov/pub/ferminews/ferminews03-01-31/p2.html

- Advanced Computing & Analysis techniques Workshop summary
  http://cerncourier.com/cws/article/cern/28410

- Mentoring of undergraduate students under a variety of programs –

  http://www.fnal.gov/pub/today/archive_2005/today05-02-24.html
  http://www.fnal.gov/pub/ferminews/ferminews03-01-31/p2.html
  http://www.highbeam.com/doc/1N1-118722B9F3633A48.html